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ABSTRACT

The Defense Technical Information Center (DTIC), an organization charged with providing information services to the Department of Defense (DoD) scientific and technical community, actively seeks ways to promote access to and utilization of scientific and technical information (STI) databases, online services, and networks relevant to the conduct and management of research and engineering (R&E) programs. One of the most important efforts in this area is the development of a DoD Gateway Information System (DGIS), which will provide online, streamlined methods for identifying, accessing, searching, post-processing, and analyzing data from heterogeneous databases of interest to the DoD R&E community, and allow queries of the database using a common command language. This series of reports provides the following information: (1) the characteristics required in the DGIS and the development approach for designing a prototype system; (2) a bibliography of publications resulting from the DGIS program of the DTIC and the Technology Information System (TIS) system prototype; (3) a description of the data collection, database design, implementation, menu-driven interface, and future directions of the DGIS Directory of Resources; (4) a description of DGIS developments and evaluations to date; and (5) a discussion of the development of the DGIS menu system. (KM)

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# THE DoD GATEWAY INFORMATION SYSTEM

October 1985

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Defense Technical Information Center (DTIC) is sponsoring development of a DoD Gateway Information System (DGIS) to provide online, streamlined methods for identifying, accessing, searching and analyzing data from heterogenous databases of interest to the DoD community. Present-day access to information resources (data- bases) is limited since each database has its own complex access procedure and command language. In addition, results from multiple databases cannot be combined or analyzed easily by the user. The Gateway will provide DoD researchers and managers access to many different databases using a single, simple access procedure. Queries of databases will be performed using a common command language, relieving the system user of the need to learn and master

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19. ABSTRACT (Continued)

separate languages and procedures for each database accessed. A prototype system is under development at the Lawrence Livermore National Laboratory. The characteristics required in the DGIS and the development approach for designing a prototype system are described.

# THE DoD GATEWAY INFORMATION SYSTEM

by

Gladys A. Cotter

## ABSTRACT

The Defense Technical Information Center (DTIC) is sponsoring development of a DoD Gateway Information System (DGIS) to provide online, streamlined methods for identifying, accessing, searching and analyzing data from heterogenous databases of interest to the DoD community. Present-day access to information resources (databases) is limited since each database has its own complex access procedure and command language. In addition, results from multiple databases cannot be combined or analyzed easily by the user. The Gateway will provide DoD researchers and managers access to many different databases using a single, simple access procedure. Queries of databases will be performed using a common command language, relieving the system user of the need to learn and master separate languages and procedures for each database accessed. A prototype system is under development at the Lawrence Livermore National Laboratory. The characteristics required in the DGIS and the development approach for designing a prototype system are described.

## INTRODUCTION

The Defense Technical Information Center (DTIC) is charged with providing information services to the Department of Defense scientific and technical community. These services range from collecting and disseminating bibliographic information to sponsoring and directing research into innovative information handling technologies. Through this research, DTIC actively seeks ways to promote access to and utilization of, Scientific and Technical Information (STI) databases and online services and networks relevant to the conduct and management of research and engineering (R&E) programs. One of the most important efforts in this area is the development of a DoD Gateway Information System (DGIS). The DGIS will provide online, streamlined methods for identifying, accessing, searching, post-processing, and analyzing data from heterogeneous databases of interest to the DoD R&E community.

The necessity for the DGIS springs from the burgeoning proliferation of databases containing STI and the absence of accepted information handling standards within the industry. These factors of proliferation and lack of standards have produced severe barriers between information seekers (in our case, DoD researchers) and the information they require.

The current method for searching a database by use of a remote terminal requires that the researcher identify and access an appropriate distant computer and follow the unique search practices that have been programmed into it. The normal search requires that several databases be accessed, probably more than once each, and the researcher is burdened with interpreting and following a different instruction manual for every system. The product of the search is a

volume of printed matter that must be culled for the relevant material that is to be retained for use. For the infrequent user, most of the time and effort expended in a search are nonproductive; they are given over to identifying appropriate databases, accessing them, reading instruction manuals, and cutting and pasting printouts. The need is for the resulting information product, which takes relatively little time to assemble. The rest of the search process is expensive overhead.

The DGIS is being developed to eliminate the unproductive portion of the search process and allow researchers to spend their time utilizing the resultant information.

Our ultimate objective is to develop a system which can respond to a researcher's information need by locating the appropriate databases, conversing with them on the researcher's behalf, and providing a single, final, relevant information product. We are proceeding towards this goal in stages which we believe are realistic from technological and budgetary viewpoints.

## DOD GATEWAY INFORMATION SYSTEM (DGIS) CHARACTERISTICS

The major requirements of the DGIS were established through DTIC user community surveys and site visits. In the process of identifying requirements for the DGIS, six critical areas surfaced. These areas are a gateway user interface, a directory of databases, database connection routines, common data retrieval routines, simultaneous search capabilities, and data analysis and post-processing routines.

### Gateway User Interface

Designing a Gateway user interface so that the Gateway itself is simple to use, is the key to the success of this system. The DoD researcher may choose to interrogate the system directly or request that an intermediary such as a librarian or information specialist perform the search. The optimal interface for a DoD researcher or so-called "end user" of information is different from the optimal interface for an information intermediary. Therefore, distinctive system interfaces or user views must be tailored and designed for specific categories of users.

In addition, experience has taught us that even within the same user category different modes of operation are required. Novice and expert modes are vital and an intermediate mode is highly desirable. This allows an infrequent or new user to utilize numerous tutorial aids or menus to interact with the system at the novice level. (The frequent user also has the option of using these aids.)

The system becomes almost self-teaching and the notorious learning curve syndrome which often turns into a drop-out syndrome is avoided. As the user becomes proficient in the use of the system, these once helpful aids become cumbersome and repetitive. Frequent users, having learned the system, need to have an expert or intermediate mode available so that they can execute system options swiftly and directly.

## Directory of Databases

There are over 3000 databases available online that contain scientific and technical information of interest to the DoD, and that number will continue to increase. The availability of these databases is a double-edged sword to the researcher. It presents the opportunity to acquire pertinent information, expand one's knowledge base, and accelerate the pace or increase the quality of the research. Conversely, the vast number of databases available makes maintaining an awareness of their existence and scope an awesome task for any researcher or even an information intermediary who has this responsibility.

To alleviate this problem, a Directory of Databases will form the core of the DGIS. The Directory will be maintained centrally by a staff at DTIC and shared throughout the DoD community so that a common body of knowledge concerning database existence will pervade the community. The directory itself will contain information on the content and scope of the available databases. The Directory will be subject-searchable so that upon entering the topic of interest the researcher will be provided with a list of appropriate databases.

## Database Connection Routines

It is difficult, time consuming, and often frustrating for infrequent users to master a plethora of database "sign-on" procedures. Such procedures include dialing telephone numbers to access database host computers directly or to access valued-added networks (VANs) such as TYMNET and TELENET which will route the user to the database host. They also include executing system-specific protocols and entering appropriate password information. A single misplaced carriage return can bar a would-be user from connection. Even a seasoned user who requires access to more than five different database systems experiences difficulties which grow exponentially as the number of databases increases. Users who require access to multiple databases often resort to posting access methods, including passwords, in public areas. This defeats security, one of the basic reasons for these procedures in the first place.

Through the DGIS, database connection routines will be automated and protected. Authorized users will be able to issue a simple connect command and be linked with the information resource they desire to search.

## Common Data Retrieval Routines

As noted earlier, the proliferation of databases has been accompanied by a lack of accepted design standards within the industry. This is particularly evident in the area of commands for information retrieval. Attempts to develop an International Standards Organization standard in this area have been unsuccessful to date. On the most basic level, the command to initiate a search varies from system to system. Neither the DoD researcher nor the information intermediary can afford the time to master the command language of each online system he or she accesses and keep up with their changes. In the case where particular databases are accessed infrequently, the expertise required to retrieve even moderately relevant information may take years to develop.

The DGIS will eventually support a common data retrieval routine for querying diverse databases. This feature will relieve the user of the need to learn and master separate commands and protocols for each database accessed.

The DGIS will be responsible for translating between its retrieval command set the native command sets of the diverse databases it queries on the user's behalf. All translation and protocol conversion will be transparent to the user.

Simultaneous Search Capabilities

Information relevant to the researcher's need will often be scattered among numerous databases. Therefore, the need exists to run the same search query against multiple databases simultaneously. Search results will be viewable on the terminal screen foreground, or may be relegated to the background freeing the screen for other activities. All search results will be downloaded from the remote database to the user's files on the DGIS as directed by the user and will be accessible by a single terminal.

Data Analysis and Post-Processing Routines

Often information retrieved from diverse databases requires analysis or post-processing to become useful to the researcher. Automated methods for analyzing the data are often the only practical way to deal with the sheer volume of information obtained. The ability to reformat, merge, sort and analyze data downloaded from remote databases to the DGIS catalyzes the transformation of an information glut into information gold.

**DEVELOPMENT APPROACH**

Having identified the major requirements of the DGIS, we sought to establish whether or not a software product was available which could serve as the basis for the DGIS. The software package which most closely met our needs and showed potential for being developed further to embody the DGIS characteristics was brought to our attention by the Department of Energy (DOE). DOE was sponsoring the Lawrence Livermore National Laboratory (LLNL) in its development of an intelligent gateway, the Technology Information System (TIS).

TIS was running in prototype mode at LLNL on a VAX 780 utilizing the UNIX operating system and the INGRES database management system. The communications and post-processing capabilities available on TIS were highly-applicable to the DoD requirements. Some of these features are highlighted below:

Communications Capabilities

Communications capabilities are the backbone of any gateway system and TIS has many outstanding features here. Users can access TIS via TYMNET, ARPANET, FTS, WATS and commercial phone lines. After login, many communications options are available. I will focus on electronic mail, write, link, connect, dial, and download.

Electronic Mail

Electronic mail service is available to all TIS users twenty-four hours a day. Standard electronic mail features such as send, receive, answer, and forward, are incorporated. Mail messages can be sent simultaneously to multiple addresses, with lengthy documents attached if needed. Users recognize the benefits of being able to communicate with numbers of people at the same time

and of avoiding the call-back routine. Messages can be filed for future reference or deleted from the system upon command.

Write

Write is another communications option which allows users online to communicate with each other via their terminals. You first enter the command %WHO to get a display list of who is currently online. You then enter the command %WRITE, followed by the name of the user you wish to communicate with, which notifies that user, who then has the option of responding. The WRITE command is only useful, of course, when parties who want to communicate are at their terminals, by chance or arrangement, at the same time.

Link

The LINK command allows users at different and various locations to link their terminals so that they are viewing the same data display. All users have control over the display and can issue commands at will. Of course, linking necessitates a cooperative spirit and some coordination.

Connect

The CONNECT command provides users with automatic access to information resources. Users do not have to know telephone numbers, ARPANET locations, passwords, access protocol or logout protocol. The user issues the CONNECT command and a data resource name. TIS then attempts to establish a connection to the resource and logs the user in. TIS uses TYMNET, TELENET, ARPANET, COMMERCIAL TELEPHONE, and FTS to establish connections.

The CONNECT command can be used to access information centers worldwide. In order to be eligible to use the CONNECT command for access to a resource, a TIS user establishes an account with that resource and obtains the required access identification information, such as passwords, to be programmed into the gateway by the TIS Database Administrator. The billing process is unaffected by gateway access. Vendors maintain the same billing structure and users maintain the same reimbursement structure, regardless of the TIS access procedures. TIS has several levels of security to ensure that password integrity is not violated.

Dial

Users who wish to access a resource other than those listed in the TIS resource directory take advantage of the DIAL command, rather than the CONNECT command. DIAL allows users to call any information center, computer, or terminal, no matter where the location. Using DIAL implies that the user knows the necessary passwords and telephone numbers. DIAL allows the user to access an off-network facility while retaining TIS capabilities such as downloading and file transfer.

Downloading

Once you are connected to a resource through TIS, you can download data from that resource. Downloading data opens many options to you. For example, you can review it at your own pace, merge it with other data, and share it with

other users by allowing them to access your file. You can also transfer your file to other users so that they can manipulate the data to suit their own needs. TIS allows you to share your data selectively on a worldwide basis.

Post Processing

TIS offers a library of post-processing routines for numeric and bibliographic data. In order to execute post-processing routines, users must download the data into a TIS file. Post-processing routines for bibliographic data are available for selected resources. Some of the available routines are REVIEW, PLOT, PERMUTE, CROSS-CORRELATE, and CONCORD.

REVIEW allows users to process citations and determine relevance at their convenience. Users are presented with the author, title, date and several lines of an abstract. Based on this information they may choose to continue to work with the citation or discard it and move on to the next. If they continue to work with the citation, they may add local options, which include assigning relevancy values and index categories that are searchable. Users also can flag citations for which they wish to order the full text, plus add their own comments to a citation.

The PLOT routine allows users to generate bar charts representing the yearly publication rate for a subject area, personal author, or corporate author. This type of graphic representation makes growth trends immediately apparent.

PERMUTE provides statistics on the frequency of occurrence for descriptive terms in the citations. Single and compound expressions containing up to four terms are analyzed. These terms are presented in alphabetic order, preceded by the number of occurrences.

The CROSS-CORRELATION and CONCORD routines analyze the relationships among data elements chosen by the user. These routines provide intelligence that is very tedious to extract manually from standard bibliographies.

**STATUS**

Our review of existing TIS capabilities and discussions between the DOE and the DoD where mutual goals regarding information access were identified, led DTIC to enter into a joint DOD-DOE development effort. TIS is serving as the basis for, and LLNL is the major developer of, the DGIS.

At the present time, all DGIS development, test, and evaluation is taking place on the prototype system at LLNL. DTIC is sponsoring a number of DoD user entities who have agreed to test the system in their operations and make recommendations regarding its evolution into a DoD Gateway Information System. These users are issued passwords and dial into the LLNL prototype via TYMNET or WATS lines. TIS orientations are provided at DTIC or at the user's location through TIS linking technology.

Testing of the DGIS prototype will begin in October 1985 and will continue for a 12-month period. The purpose of the test is to demonstrate "proof-of-concept." To this end, the characteristics required in the DGIS will be tested within the limited universe of seven diverse database systems.

Through the DGIS prototype, users will be able to automatically connect to heterogenous databases, simultaneously search them and post-process and analyze the retrieved data. A directory for these database systems has been developed. The common data retrieval routines are still under development. A test version is scheduled for implementation on the prototype in April 1986. It is anticipated that artificial intelligence or expert system applications may prove very valuable in this area. Success of the prototype will result in its operational implementation and expansion of the number and type of databases accessible.

Implementation of the DGIS will provide DoD's scientific and technical community with a powerful, responsive information tool. The DGIS will render timely, comprehensive information to DoD research, development, and engineering programs. The productivity enhancement within the community resulting from this information will more than offset the investment made in DGIS development and operating cost.

# — DGIS —

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# DOD GATEWAY INFORMATION SYSTEM

# BIBLIOGRAPHY

## OF ACTIVITY RELEVANT & GENERATED PUBLICATIONS

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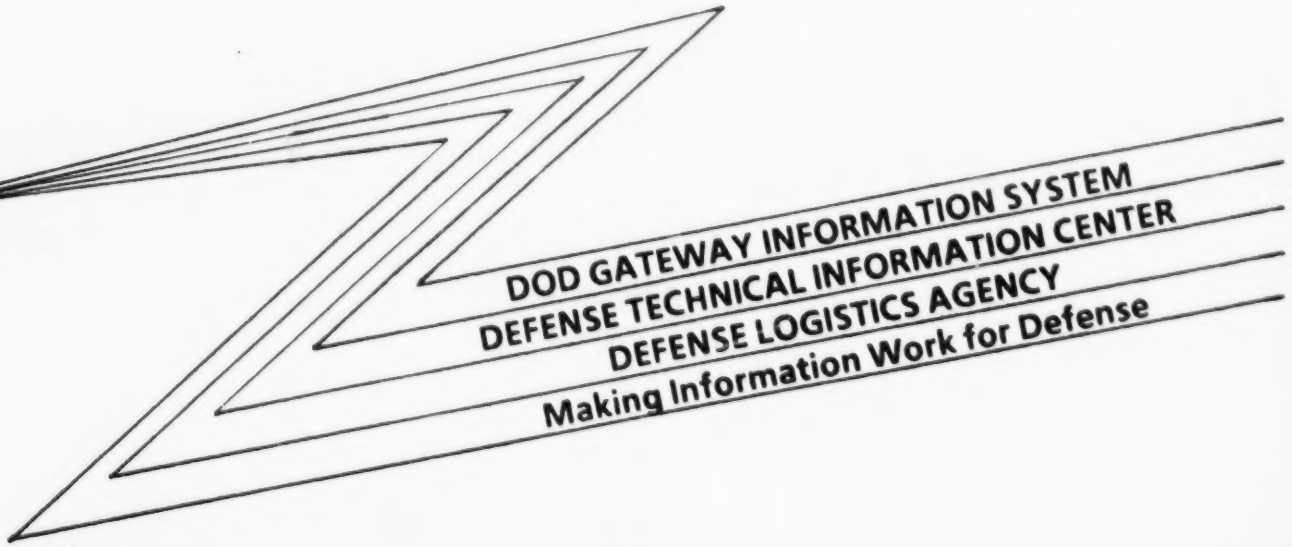
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DoD GATEWAY INFORMATION SYSTEM (DGIS)>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>publications

This bibliograhy is a listing of publications resulting from the efforts DoD GATEWAY INFORMATION SYSTEM (DGIS) Program of the Defense Technical Information Center (DTIC) and the TECHNOLOGY INFORMATION SYSTEM (TIS) of the Lawrence Livermore National Laboratory (LLNL). This listing is aimed at giving background to DGIS development, and therefore the TIS publication listing inclusions are incomplete.

## I. DGIS CONCEPT

DTIC: Cotter, G. A.: The DoD Gateway Information System. October 1985, AD-A161 701.
****Development of the DoD Gateway Information System to provide online, streamlined methods for identifying, accessing, searching and analyzing data from databases of interest to the DoD community.
****Presented at IEEE Conference, Williamsburg, VA, Oct 1985.

DTIC: Cotter, G. A.: The DoD Gateway Information System: Prototype Experience. Apr 86, AD-A166 200.
****DGIS is being developed to provide the DoD community with a modern tool for accessing external databases and extracting information products from them. Developments and evaluations to date are described.
****Presented at National Online Meeting, NY, May 1986.

## II. GATEWAY CONCEPT

LLNL: Hampel, V. E., et al.: "TIS" An Intelligent Gateway Computer for Information and Modeling Networks: Overview. August 1983, UCRL-53493, DTIC AD-A135 916.
****Development of software for Intelligent Gateway Computers (IGC) suitable for the prototyping of advanced, integrated information networks.

LLNL: Burton, H. D.: The Intelligent Gateway: A Dynamic Resource Environment. July 1985, UCRL-93125.
****Concept of gateways and front-ends to facilitate access to the growing multiplicity of computer based resources.
****Prepared for Ninth International OnLine Information Meeting, London, England, Dec 85.

DTIC: Cotter, G. A.: An Intelligent Gateway for the Department of Defense: The Technology Information System. June 1984, AD-A133 800.
****DTIC is directed by OUSDRE(R/AT/R/LM) to be the DoD focal point for development of an intergovernmental intelligent gateway computer system.
****Presented at AF Scientific and Technical Information Officers Policy Conference, Alexandria, VA, Jun 84.

LLNL: Berch, M. C.: The UNIX Connection. UNIX Review, V4N5, May 1986, pp.44-53.
****Partially technical and historical recounting of application of the TIS-developed Intelligent Gateway Processor (IGP) approach to tying together disparate systems, using UNIX-based services.

## III. DGIS DEVELOPMENTS AND APPLICATIONS

### A. DGIS-SPONSORED ACTIVITIES

DTIC: Powell, M. E.: Selected Papers from the First Conference on Computer Interfaces and Intermediaries for Information Retrieval, Held October 3-6, 1984, Williamsburg, Virginia. May 1986, AD-A167 700.
****This conference took place to promote exchange and dissemination of research efforts toward improvement in information retrieval, with emphasis on human-computer interaction and needs.

DTIC/MIT: Jacobson, C. E., et al.: Proceedings of the Second Conference on Computer Interfaces and Intermediaries for Information Retrieval, May 28-31 May 1986, Boston, Massachusetts. May 1986, DTIC/TR-86/5.
****This conference, as an update of the previous one, brought together experts in userfaces and gateways, with additional emphasis on artificial intelligence in retrieval, common command language, and natural language.
****Co-sponsored with the Massachusetts Institute of Technology.

### B. DGIS DIRECTORY OF ONLINE RESOURCES

DTIC: Jacobson, C. E. et al.: Directory of DoD-Sponsored R&D Data Bases. September 1984, AD-B085 600.
****Lists 439 DoD R&D databases by database name, dates of coverage, points of contact, hardware/software configuration, and discription. Agency, database, and subject indices are included.
****This publication provided foundation for the DGIS Online Directory.

DTIC: Chastain, G.: A Study of User-Defined Searching Requirements for the On-Line Version of the Directory of DoD-Sponsored R&D Data Bases on the Defense Gateway Computer System. March 1985, AD-A153 000.
****This study surveyed user searching requirements of a DGIS online resource directory. The survey provides recommendations for a user-friendly interface for the online directory.

DTIC: Jacobson, C. E. et al.: The DoD Gateway Information System Directory of Resources. In ASIS: Database Management: Building, Changing, and Using Databases; Collected Papers and Abstracts, 15th Mid-Year Meeting. Paper No. 13, May 1986.
****The core of the DGIS is a Directory of Resources which contains information on the content, scope, and availability of selected databases. The prototype Directory is built on the INGRES dbms using a menu-driven interface. This paper describes data collection, database design, implementation, and future directions.
****Presented at ASIS Mid-Year Meeting, Portland, OR, 11-14 May 1986.

DTIC: [ ]: Directory of Resources, DRAFT Documentation, Version 1. [May? 1986].
****Describes preliminary version, as an INGRES-based demonstration system. Version I shows searching by database name, acronym, producer, and descriptors. Version II will be an enhanced version, and version III is planned operational version. Includes menu displays.

C. DGIS INTERFACE DESIGN

DTIC: Kuhn, A. D., et al.: The DoD Gateway Information System (DGIS): User Interface Design. [September 1986]
****A DGIS menu system was designed to guide the user through the paths of accessing and processing information in an organized and logical manner, using the multitude of capabilities on DGIS.
****Presented at and in Proceedings of 49th Annual Meeting of the American Society for Information Science, Chicago, IL, 28 Sep-2 Oct 1986.

D. DGIS COMMON COMMAND LANGUAGE

NISO: [ ] American National Standard -- For Information Sciences Common Command Language for Online Interactive Information Retrieval. ANSI Z39.58-198X, DRAFT, [March] 1986.
****CCL draft and call for comments. Developed by the National Information Standards Organization (NISO)(Z39) committee. Includes Z39 participants.

E. DGIS USER SERVICES

DTIC/BBN: [Hushon, J., et al.]: Users Guide to DGIS. Gateway User Support and Training Office (GUSTO), BBN Labs. Inc., Arlington, VA. March 1986.
****DGIS users manual to the DGIS system, based on functions and menus.

DTIC/BBN: [Hushon, J., et al.]: DGIS Workbook. Gateway User Support and Training Office (GUSTO), BBN Labs. Inc., Arlington, VA. March 1986.
****Easy-to-follow review of the DGIS menu system, its functions and responses.

IV. POST-PROCESSING

LLNL: Bollinger, W. A., et al.: User Requirements, Post-Processing of Bibliographic Information. February 1984, UCAR-10114.
****Describes the requirements, motivation, needs, and cost benefits expected in the post-processing capabilites of data from the three large federal information systems: DOE/RECON, NASA/RECON, and DoD/DROLS.

LLNL: Bollinger, W. A., et al.: Post-Processing of Bibliographic Citations from DOE/RECON, NASA/RECON, and DOD/DROLS. August 1984, UCRL-89995-Rev-1.
****Results of the development of an interactive, self-guided program for the joint post-processing of bibliographic citations from the major federal information centers.
****Prepared for presentation to Eighth International Online Information Meeting, London, England, Dec 84.

LLNL: Burton, H. D.: Bibliographic Post-Processing with the TIS Intelligent Gateway: Analytical and Communication Capabilities. September 1985, UCID-20529.
****Describes and demonstrates the capabilities of the PROCESS functions of the TIS Intelligent Gateway, to support bibliometric analysis of databases.

LLNL: Burton, H. D.: Non-Standard Post-Processing Functions. July 1985 (3p.)
****Contains instructions for use of miscellaneous post-processing functions: new version of 'plot'; translators for DIALOG, SDC, BRS; 'select' function on data fields.

V. LOCAL AUTOMATION MODEL interface with DGIS

DTIC: Cotter, G. A., et al.: Integrated Bibliographic Information System: Integrating Resources by Integrating Information Technologies. May 1985, AD-A157 700.
****Development of an integrated library system combined with an intelligent gateway capable of querying and updating simultaneously more than one heterogeneous bibliographic database.
****Presented at National Online Conference, New York, May 85.

DTIC: Cotter, G. A., et al.: The Integrated Bibliographic Information System: Resource Sharing Tailored for Local Needs. Nov 1985, AD-A161 700.
****In promoting resource sharing for speeding access to information, the IBIS will query databases using a common command language, download and post-process data, and allow libraries to tailor search results derived from external sources and a local catalog.
****Presented at Ninth International Online Meeting, London, December 1985.

LLNL: Burton, H. D.: Integration of an Automated Library Support System with an Intelligent Gateway. August 1984, UCRL-91383.
****Describes projects for evaluating library support packages and integrating the most desirable system with the TIS gateway to provide a comprehensive prototype for libraries and information centers.
****Prepared for presentation to Integrated Online Library Systems, Atlanta, GA, Aug 84.

LLNL/DTIC: Burton, H. D., et al.: Resource Sharing through Integration of an Intelligent Gateway and Library Support Software. Special Libraries, Wtr 1986 V77 N1 pp.28-35. AD-A165 050.
****Integration of an intelligent gateway computer system with a commercial, online support system is undergoing testing for DoD libraries, to promote resource sharing in a distributed environment.

DTIC/LMI: Hartt, R. W., et al.: Microcomputer-Based Local Automation Model: System Planning Guidance. May 1986, AD-A168 136.
****Provides guidance to DoD libraries on implementing the micrcocomputer-based LAM. Tasks include decisions in automating functions, peripheral equipment, telecommunications, and cost estimates.

VI. DEFENSE APPLIED INFORMATION RESEARCH CENTER (DAIRC)

DTIC/CDC-ALXFAC: Malamud, C., et al.: Defense Applied Information Research Center: Overview of Activities (Last Revised July 10, 1986).
****Briefing vu-graphs of operation and network architecture concepts for the proposed DAIRC. Role, 1987 efforts, budget, Defense Virtuaql Network, full text retrieval system, DGIS.

VII. SECURE GATEWAY CONCEPT

WHS/DCOAR: Doty, K., et al.: System Requirements: Secure Gateway. Task I Working Paper, Coordination Draft. June 1986. Distrib limited to USGO.
****SDIO has requested that the technical feasibility of a secure gateway be studied concerning costs, time frame, security requirements, and protection of data. The term 'Secure Gateway' is defined as applying to hardware, software, communications, and procedures integrated to perform the needed SDIO capability.

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# THE DoD GATEWAY INFORMATION SYSTEM DIRECTORY OF RESOURCES

C. E. Jacobson and G. A. Cotter

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DTIC Defense Technical Information Center

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Defense Technical Information Center (DTIC) is sponsoring development of a DoD Gateway Information System (DGIS) to provide online, streamlined methods for identifying, accessing, searching and analyzing data from heterogeneous databases of interest to the DoD community. At the core of the gateway system is a Directory of Resources which contains information on the content, scope and availability of selected databases. Presently, the Directory references over 430 DoD-sponsored R&D databases, but this figure is expected to grow to over 3,000 when coverage is expanded to include additional DoD, other federal, and commercial databases. The prototype Directory runs on a VAX 11/780 minicomputer using the INGRES database management system and is available to a select community of users for test and evaluation. A critical feature is the menu-driven interface designed to assist end-users. This paper describes data collection, database design, implementation of the Directory and menu-driven interface, and future directions.

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# THE DOD GATEWAY INFORMATION SYSTEM DIRECTORY OF RESOURCES

Carol E. Jacobson and Gladys A. Cotter

The Defense Technical Information Center (DTIC) is sponsoring development of a DoD Gateway Information System (DGIS) to provide online, streamlined methods for identifying, accessing, searching and analyzing data from heterogeneous databases of interest to the DoD community. At the core of the gateway system is a Directory of Resources which contains information on the content, scope and availability of selected databases. Presently, the Directory references over 430 DoD-sponsored R&D databases, but this figure is expected to grow to over 3,000 when coverage is expanded to include additional DoD, other federal, and commercial databases. The prototype Directory runs on a VAX 11/780 minicomputer using the INGRES database management system and is available to a select community of users for test and evaluation. A critical feature is the menu-driven interface designed to assist end-users. This paper describes data collection, database design, implementation of the Directory and menu-driven interface, and future directions.

Online Directories, Database Management Systems, Gateways, Database Design, Requirements Analysis

## 1. INTRODUCTION

The Department of Defense (DoD) Research and Engineering community requires rapid, easy access to scientific and technical information (STI) relevant to its mission. This information is contained in a multiplicity of databases maintained within the federal and commercial sectors. The Defense Technical Information Center (DTIC) has as its mission the acquisition, storage, retrieval, and dissemination of STI to support the management and conduct of DoD research, development, engineering, and studies programs. Therefore, DTIC is developing the DoD Gateway Information System (DGIS) to provide this community with a modern tool for identifying, accessing, and interrogating these databases (Ref. 1).

A primary component of DGIS is the Directory of Resources, a database of databases. The Directory contains information on the content and scope of databases relevant to DoD. It is subject-searchable so that upon entering the topic of interest the user is provided with a list of appropriate databases. This paper describes data collection, database design, implementation of the Directory, and future directions.

## 2. DATA COLLECTION

Databases of interest to the DoD community are found within the academic and commercial sectors, as well as the federal sector. There are many directories and vendor services available that aid in the identification of commercial and prominent federal databases relevant to DoD. Based on descriptions provided by these sources and, in some cases, follow-up telephone calls to database producers, databases were selected for inclusion in the Directory.

Unfortunately, identification tools were not readily available for many of the small, specialized DoD databases. To fill this void, a questionnaire was developed and distributed to over 1200 of DTIC's DoD users. Over 430 research and development (R&D) databases were identified (Ref. 2). Data was collected on the content, scope, and availability of the databases. In addition, subject index terms were assigned to databases selected for inclusion in the Directory.

The databases identified thus far have provided a starting point for the Directory. It is estimated that less than 40 percent of the DoD R&D databases were identified during the first survey. A follow-on effort is planned. In addition, the directories and vendor services utilized to identify databases will be monitored for new entries.

## 3. DATABASE DESIGN

### 3.1 User Requirements

To determine user needs for the Directory database, a dual-purpose questionnaire was designed. The questionnaire was used to determine data elements and user interface requirements for the database. Present and potential users of the DGIS were queried, and the results were tabulated and analyzed (Ref. 3). Both end-users and intermediaries were included in the survey. The users requested that the following data elements be searchable in the Directory:

Database Name
Acronym
Update Frequency
Beginning Date
Size
Database Producer Name
Database Producer Contact
Database Distributor Name
Database Distributor Contact
Database Generator Name
Database Generator Contact
Availability
Descriptors
Database Type
System Software
System Hardware
Classification Restrictions
Abstract
Cost
Gateway Identification and Availability
Date Entry was Last Modified

The following capabilities were requested in the system:

a. To define output formats.
b. To download information.
c. To choose menus or commands.
d. To store search strategies.
e. To store user defined formats.
f. To have a common retrieval language.
g. To require a minimum amount of keyboarding.
h. To have a menu of predefined formats.
i. To allow the user to reformat information.
j. To explain user errors.
k. To provide help screens.
l. To allow the user to select the command language.
m. To suggest related terms.
n. To display the process followed to obtain the results.
o. To allow for several levels of searching expertise.

Many of these capabilities address the issue of servicing a diverse user population made up of end-users and intermediaries The majority of DTIC's current users are librarians or information specialists, but in the future it is expected that this complexion will change. It is anticipated that the end-user community (principally scientists, engineers, and managers) wil be a growth area for DTIC and DGIS in the next 10 to 15 years. Given this fact, it is important to build capabilities such as menus, detailed error messages, and help screens. Providing for different levels of searching expertise has become very important.

### 3.2 Database Management System (DBMS)

The DGIS, of which the Directory is a fundamental part, runs on a VAX 11/780 minicomputer configuration with UNIX as the operating system and INGRES as the database management system. INGRES is a relational database management system originally developed by the University of California, Berkeley and now marketed by Relational Technology, Inc. The first question to be resolved was whether INGRES was suitable for the Directory or whether a second DBMS should be selected.

INGRES, it turned out, was an acceptable DBMS for the Directory. It provided features that satisfied many of the capabilities desired by the users. With INGRES, DGIS users will be able to search the Directory by using commands (for the experienced user) or menus (for the novice). Thus, the Directory will accommodate various levels of searching expertise.

The menus are clear, concise, and easy to read. Rules of consistency are applied throughout. In each menu, HELP is H, BACK UP is B and EXIT is E. Each menu has HELP screens associated with it which provide a more detailed explanation of the options. There are also HELP screens which describe each of the searchable and displayable fields. By using commands (native INGRES), the experienced user will be able to search on a wider variety of fields and to display database records in a wider variety of formats.

## 4. IMPLEMENTATION OF THE DIRECTORY

The Directory is now in a prototype phase. Menus have been developed and are being tested (Ref. 4). Figure 1 is the main menu which you will encounter when you log onto the DGIS (Ref. 5).

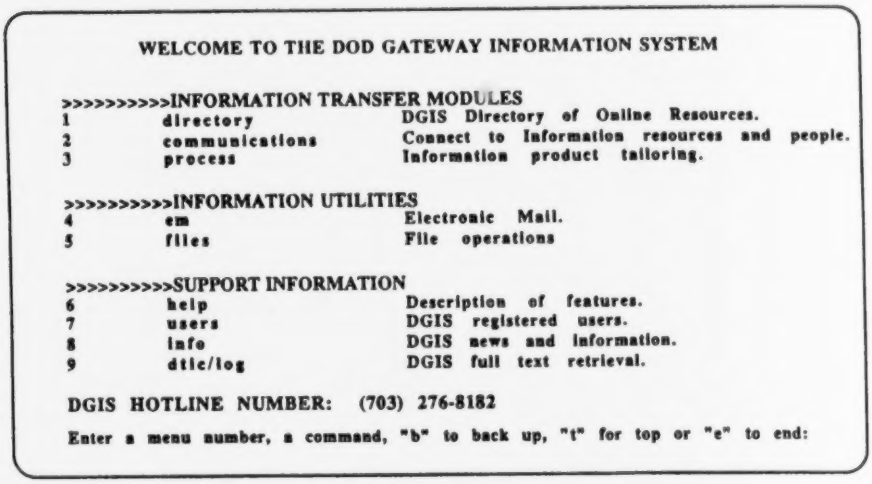
WELCOME TO THE DOD GATEWAY INFORMATION SYSTEM
>>>>>>>>>>INFORMATION TRANSFER MODULES
1 directory DGIS Directory of Online Resources.
2 communications Connect to Information resources and people.
3 process Information product tailoring.
>>>>>>>>>>INFORMATION UTILITIES
4 em Electronic Mail.
5 files File operations
>>>>>>>>>>SUPPORT INFORMATION
6 help Description of features.
7 users DGIS registered users.
8 info DGIS news and information.
9 dtic/log DGIS full text retrieval.
DGIS HOTLINE NUMBER: (703) 276-8182
Enter a menu number, a command, "b" to back up, "t" for top or "e" to end:

Figure 1

If you wish to enter the Directory, enter menu number "1" or the command "DIRECTORY." A menu welcoming you to the DGIS Directory of Resources (figure 2) will be presented and will give you the option of using native INGRES or the menu-drived mode.

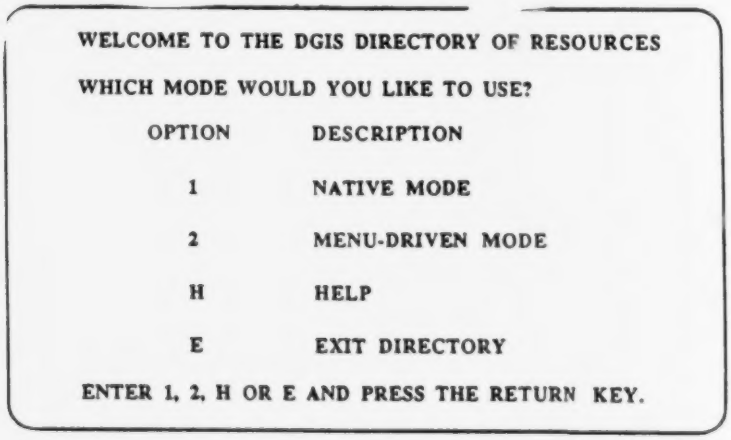
WELCOME TO THE DGIS DIRECTORY OF RESOURCES
WHICH MODE WOULD YOU LIKE TO USE?
OPTION DESCRIPTION
1 NATIVE MODE
2 MENU-DRIVEN MODE
H HELP
E EXIT DIRECTORY
ENTER 1, 2, H OR E AND PRESS THE RETURN KEY.

Figure 2

To use native INGRES, select "1." To use the menu-driven system, select "2." If you elect to use the menu-driven system, the main menu (figure 3) gives you the option of searching the Directory, displaying a known database or search set, or connecting to a known database.

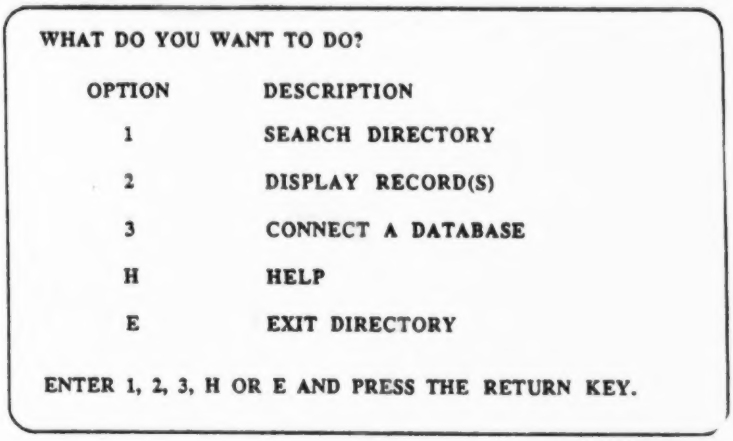


Figure 3

At this point, you can solicit "HELP" or "EXIT" the Directory. The HELP screen associated with this menu (figure 4) defines the "SEARCH," "DISPLAY," and "CONNECT" operations.

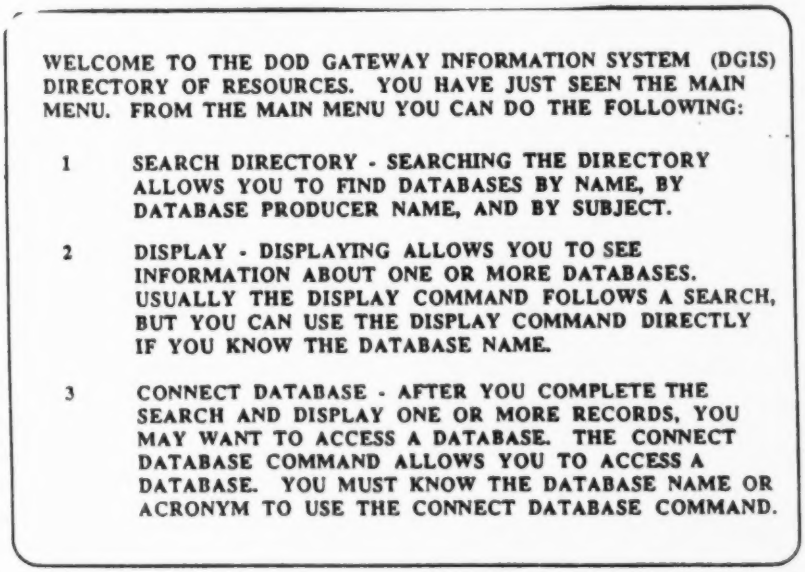
WELCOME TO THE DOD GATEWAY INFORMATION SYSTEM (DGIS) DIRECTORY OF RESOURCES. YOU HAVE JUST SEEN THE MAIN MENU. FROM THE MAIN MENU YOU CAN DO THE FOLLOWING:
1 SEARCH DIRECTORY - SEARCHING THE DIRECTORY ALLOWS YOU TO FIND DATABASES BY NAME, BY DATABASE PRODUCER NAME, AND BY SUBJECT.
2 DISPLAY - DISPLAYING ALLOWS YOU TO SEE INFORMATION ABOUT ONE OR MORE DATABASES. USUALLY THE DISPLAY COMMAND FOLLOWS A SEARCH, BUT YOU CAN USE THE DISPLAY COMMAND DIRECTLY IF YOU KNOW THE DATABASE NAME.
3 CONNECT DATABASE - AFTER YOU COMPLETE THE SEARCH AND DISPLAY ONE OR MORE RECORDS, YOU MAY WANT TO ACCESS A DATABASE. THE CONNECT DATABASE COMMAND ALLOWS YOU TO ACCESS A DATABASE. YOU MUST KNOW THE DATABASE NAME OR ACRONYM TO USE THE CONNECT DATABASE COMMAND.

Figure 4

Enter the appropriate option number or letter and the corresponding menu will be displayed. Should you strike a key other than 1, 2, 3, H, or E, an error message will be displayed (figure 5) at the bottom of the main menu and you will be returned to the main menu.

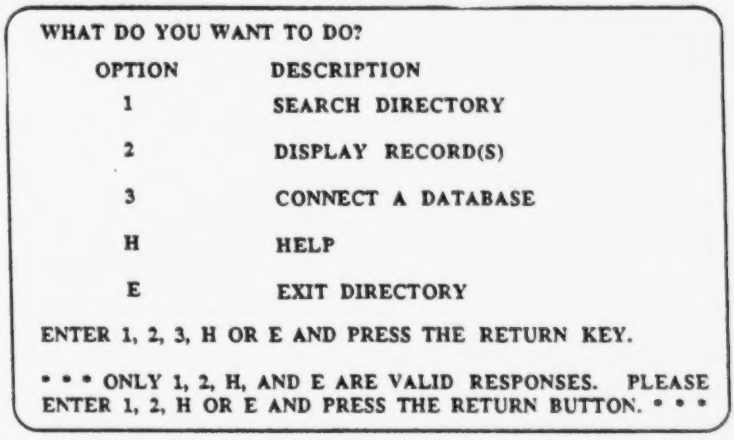
WHAT DO YOU WANT TO DO?
OPTION
DESCRIPTION
1
SEARCH DIRECTORY
2
DISPLAY RECORD(S)
3
CONNECT A DATABASE
H
HELP
E
EXIT DIRECTORY
ENTER 1, 2, 3, H OR E AND PRESS THE RETURN KEY.
• • • ONLY 1, 2, H, AND E ARE VALID RESPONSES. PLEASE ENTER 1, 2, H OR E AND PRESS THE RETURN BUTTON. • • •

Figure 5

It is anticipated that the most frequently requested option will be the SEARCH option. By entering "1," the user will be directed to the SEARCH menu (figure 6). Although there are well over two dozen searchable data elements in each record, the majority of casual or novice users are expected to search by database name, database producer name, or subject.

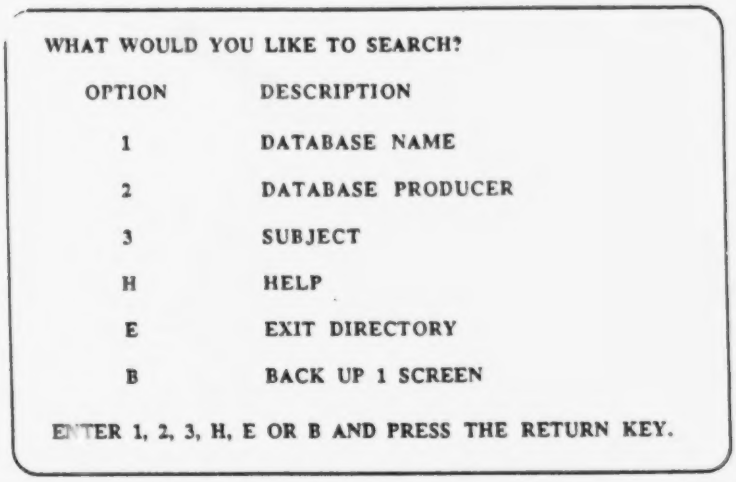


Figure 6

This menu allows you to select one of the SEARCH options, "HELP," "EXIT," or "BACK UP." Should you elect to search by database name, the system will search the acronym field, as well as the database name field. By electing to search the database producer field, you will be queried for the complete name of the organization. Should you decide to search by subject, enter "3."

The SUBJECT SEARCH option allows you to enter a series of subjects linked with the Boolean operators AND, OR, NOT. The SEARCH menu gives you not only the HELP and EXIT options as in the main menu, but also the ability to BACK UP one screen. In a primitive fashion, this BACK UP option enables you to backtrack and trace the process which you followed, a desirable capability. As in the main menu, a HELP screen and error messages have been designed specifically for this menu.

The SUBJECT SEARCH option causes the user to be solicited for subjects (figure 7). If, for example, you are interested in identifying databases dealing with "HUMAN FACTORS," you should enter "HUMAN AND FACTORS." Although this is not a traditional menu with option numbers, you can still ask for HELP, EXIT the Directory, or BACK UP.

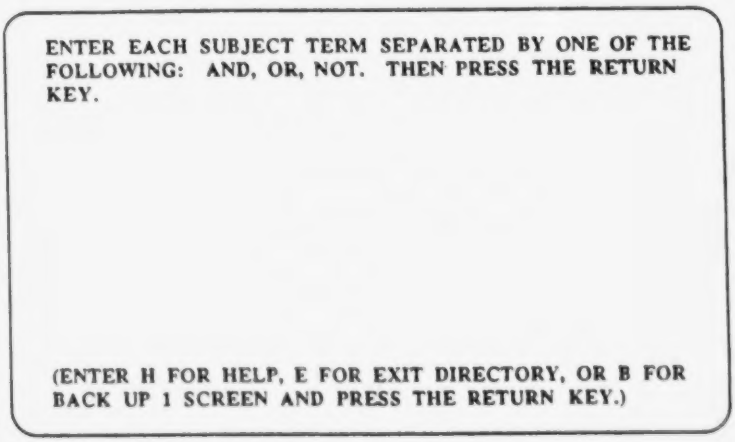
ENTER EACH SUBJECT TERM SEPARATED BY ONE OF THE FOLLOWING: AND, OR, NOT. THEN PRESS THE RETURN KEY.
(ENTER H FOR HELP, E FOR EXIT DIRECTORY, OR B FOR BACK UP 1 SCREEN AND PRESS THE RETURN KEY.)

Figure 7

Figure 8 shows that the SUBJECT SEARCH request results in a search set with four database records. Each record represents a unique database.

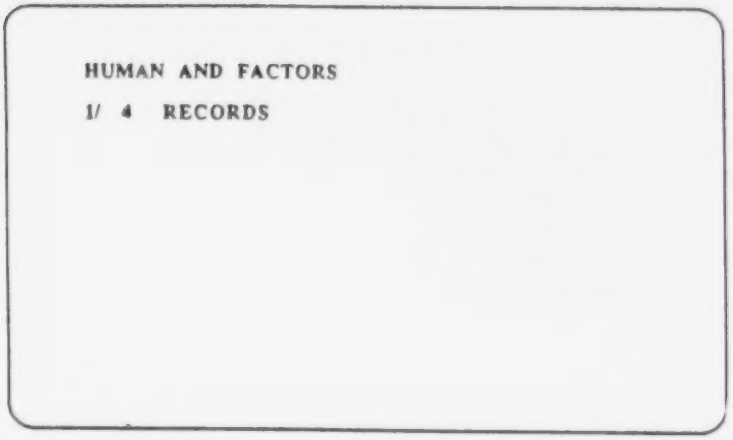


Figure 8

You will then be returned to the main menu (figure 3) where you may choose to search for another database, to display records from the previous search or the record for a known database, or to connect to a database. Should you elect to display records from the previous search, enter "2."

To display records, the system needs to know which records are to be displayed and in what format to display them. First, you are solicited for which records you would like to display (figure 9).

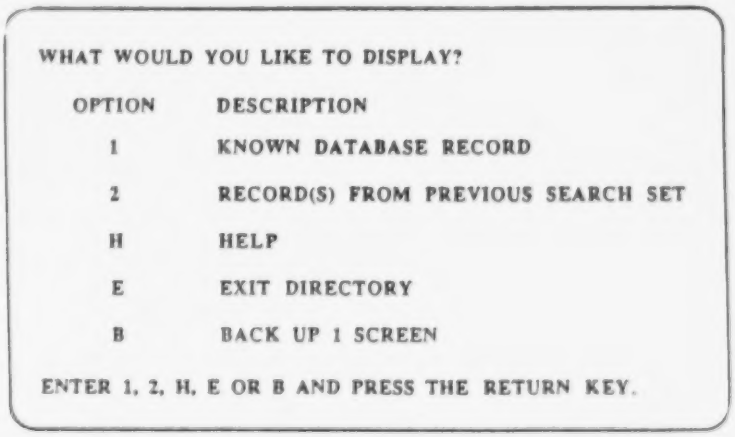
WHAT WOULD YOU LIKE TO DISPLAY?
OPTION DESCRIPTION
1 KNOWN DATABASE RECORD
2 RECORD(S) FROM PREVIOUS SEARCH SET
H HELP
E EXIT DIRECTORY
B BACK UP 1 SCREEN
ENTER 1, 2, H, E OR B AND PRESS THE RETURN KEY.

Figure 9

You have the option to display the record for a known database or records from the previous search. In addition, you can ask for HELP, EXIT the Directory, or BACK UP. At this point, you should enter "2" that you wish to see records from the previous search.

The format menu (figure 10) will appear so that you can select a display format for the records.

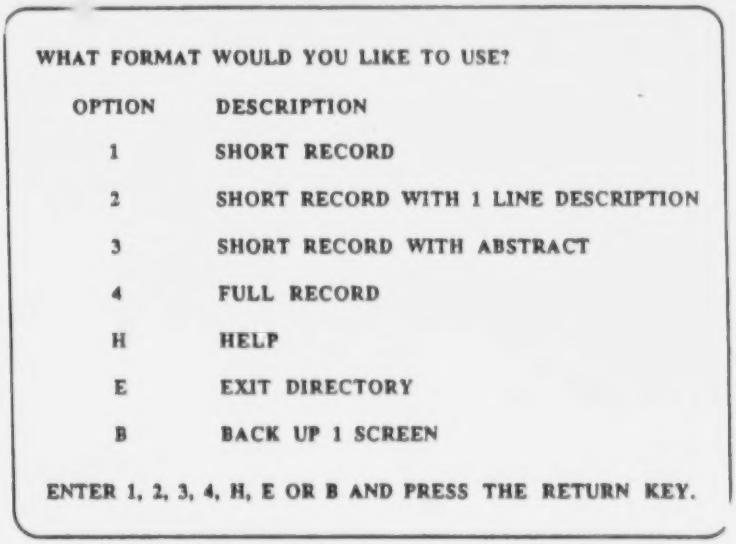
WHAT FORMAT WOULD YOU LIKE TO USE?
OPTION DESCRIPTION
1 SHORT RECORD
2 SHORT RECORD WITH 1 LINE DESCRIPTION
3 SHORT RECORD WITH ABSTRACT
4 FULL RECORD
H HELP
E EXIT DIRECTORY
B BACK UP 1 SCREEN
ENTER 1, 2, 3, 4, H, E OR B AND PRESS THE RETURN KEY.

Figure 10

Using the "SHORT RECORD" option, accession number, database name, and database producer name are displayed. With the "SHORT RECORD WITH 1 LINE DESCRIPTION" option, the accession number, database name, and first line from the abstract are displayed. The "SHORT RECORD WITH ABSTRACT" option results in a display of the accession number, database name, acronym, beginning data, database producer name, database type, abstract, and descriptors. The "FULL RECORD" option allows you to display all fields. Should you wish to see the accession number, database name, and database producer name, enter "1."

Now the system needs to know which records from the previous search set you wish to see (figure 11).

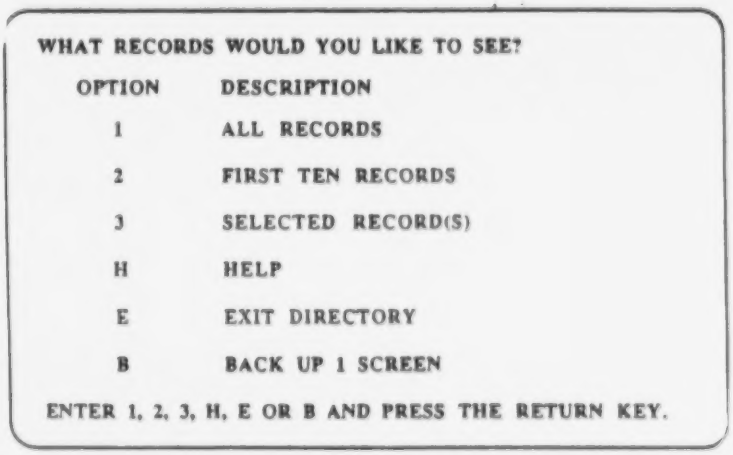
WHAT RECORDS WOULD YOU LIKE TO SEE?
OPTION DESCRIPTION
1 ALL RECORDS
2 FIRST TEN RECORDS
3 SELECTED RECORD(S)
H HELP
E EXIT DIRECTORY
B BACK UP 1 SCREEN
ENTER 1, 2, 3, H, E OR B AND PRESS THE RETURN KEY.

Figure 11

You can display all records, the first ten records (or fewer if there are less than ten records in the search set), or a selected record(s). There are only four records in the search set example, so enter "1" to display them all.

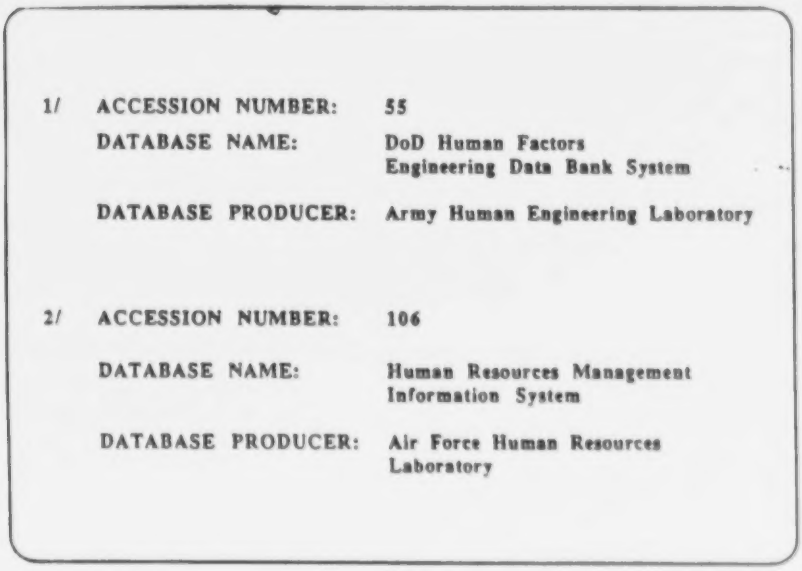
1/ ACCESSION NUMBER: 55
DATABASE NAME: DoD Human Factors Engineering Data Bank System
DATABASE PRODUCER: Army Human Engineering Laboratory
2/ ACCESSION NUMBER: 106
DATABASE NAME: Human Resources Management Information System
DATABASE PRODUCER: Air Force Human Resources Laboratory

Figure 12

The records will be displayed screen after screen until the last record is displayed (figure 12). Then you will be sent back to the main menu (figure 3). If you have access to any of the databases which you identified through the Directory, you may want to CONNECT (i.e., dial in) to them. If you do not have access to these databases, you may want to display the entire record for any or all of the databases which you retrieved in your search. In this way you can identify a person to contact in order to gain access to the database(s). At this point, you also have the option of leaving the Directory. By entering "E" for EXIT, you will revert to the DGIS main menu (figure 1) where you can select from a number of options.

Menus used with the Directory are easy to use and require little explanation. The questions asked by the system and acceptable responses by the user are quite clear. HELP or BACK UP options are available when the user becomes confused. The menus are suitable for a novice or occasional user. As the user accesses the Directory more frequently, the choices to enter the Directory using native INGRES may be desirable.

## 5. FUTURE DIRECTIONS

The Directory of Resources is at prototype stage. It is being tested by a select group of users within DoD for 6 months. Based on their recommendations, the system will be modified to enhance performance. At the conclusion of the test period, the Directory will become operational, and the number of users will be expanded.

Development of the Directory must now move in the direction of a natural language interface, which is the optimal interface identified by the user community. Unfortunately, technology to implement such an interface in this version of the Directory is not available. It is hoped that new developments in the field of artificial intelligence will provide the needed technology within the next 5-10 years.

## 6. CONCLUSIONS

The utility of the Directory will be depend on its ease of use, comprehensive coverage, and ability to deliver results. Guidelines followed in developing the Directory emphasize those characteristics. Menus were designed to guide users through the Directory to the information they need, and command mode was made available for the convenience of frequent users. A solid core of databases was carefully selected to form the foundation of the Directory. The Directory was designed to accommodate expanded coverage and variation in data collection methods. These features combine to deliver relevant results to the user. As the scope of the Directory expands, it will provide DoD's scientific and technical information community with a powerful, responsive information tool.

## 7. ACKNOWLEDGEMENTS

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# THE DOD GATEWAY INFORMATION SYSTEM: PROTOTYPE EXPERIENCE

G. A. Cotter

April 1986

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The Department of Defense (DoD) Research and Engineering community requires rapid, easy access to scientific and technical information relevant to its mission. This information is contained in a multiplicity of databases maintained within the federal and commercial sectors. The DoD Gateway Information System (DGIS) is being developed to provide this community with a modern tool for accessing these databases and extracting information products from them.

DGIS is designed to provide the DoD researcher with a single, user-friendly system front-end that can be used to identify, access, interrogate, and post-process information from numerous databases. The DGIS transforms these database and processing resources into a single entity - a virtual database.

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The Defense Technical Information Center (DTIC) is responsible for managing the design, development, and implementation of DGIS. A prototype version of DGIS is now undergoing test and evaluation. Eight information services have been selected as targets of the prototype gateway.

The utility of DGIS will rest on the early acceptance and widespread participation of users: reactions encouraged by a design that makes quick learning and valuable results both possible and obvious. DGIS system development guidelines emphasize these design characteristics. The development effort is concentrated on integrating within a single, straightforward command structure the differing logic, syntax, and procedures intrinsic to separate databases. The design accommodates, transparent to the user, the complexities of accessing, downloading, merging, and processing information from diverse sources. This paper describes DGIS developments and evaluations to date.

# THE DoD GATEWAY INFORMATION SYSTEM: PROTOTYPE EXPERIENCE

by

Gladys A. Cotter

**Keywords**: Intelligent Gateway, Front-End, User Interface, Networking.

**Abstract**: The Department of Defense (DoD) Research and Engineering community requires rapid, easy access to scientific and technical information relevant to its mission. This information is contained in a multiplicity of databases maintained within the federal and commercial sectors. The DoD Gateway Information System (DGIS) is being developed to provide this community with a modern tool for accessing these databases and extracting information products from them.

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The Defense Technical Information Center (DTIC) is responsible for managing the design, development, and implementation of DGIS. A prototype version of DGIS is now undergoing test and evaluation. Eight information services have been selected as targets of the prototype gateway.

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## 1. INTRODUCTION

The Defense Technical Information Center (DTIC), for many years, has been charged with collecting from, and disseminating to, the Department of Defense (DoD) research information and reports generated by DoD and its contractors. This has been accomplished, in part, through the development and maintenance of the Defense Research, Development, Test and Evaluation Online System (DROLS). Citations of technical reports produced by the DoD, up to the "Secret" level, are contained in DROLS and may be retrieved by remote users via terminal. Unclassified DROLS information is provided to the National Technical Information Service (NTIS) and made available to the public.

The DTIC mission recently was expanded to include facilitating DoD access to external Scientific and Technical Information (STI) databases, online services, and networks relevant to DoD Research and Engineering Programs. The STI sources are to include other federal, commercial, and foreign databases and systems. The objective is to provide DoD with the most up-to-date, pertinent information available, regardless of source.

To meet this additional mission, DTIC elected to develop the DoD Gateway Information System (DGIS), an intelligent gateway. This intelligent gateway is to provide a simple mechanism for matching information needs with information. The gateway is to provide users with answers to the questions:

WHAT RELEVANT DATABASES EXIST?
HOW DO I ACCESS THEM?
HOW DO I RETRIEVE INFORMATION?
HOW DO I MANIPULATE THE RESULTING INFORMATION?

Stated another way, DGIS is to provide a single, easy-to-use interface for identifying, accessing, interrogating, and post-processing information from numerous databases relevant to DoD information needs. Development of DGIS is a multi-year, multi-task project. This paper describes development of a prototype DGIS which currently is undergoing test and evaluation.

## 2. PROTOTYPE INGREDIENTS

Because the project's objective was intimidating, the initial fear was not failure, but never getting started. Failure, after all, is a tangible result which can be improved upon. The best approach seemed to be to identify several achievable objectives, to devise a plan to develop and implement a prototype system encompassing them, and to subject the results to test and evaluation. The basic components of the system were to be:

A DIRECTORY OF DATABASES - SUBJECT SEARCHABLE
A COMMON METHOD FOR ACCESSING AND SEARCHING DIVERSE DATABASES
TOOLS FOR DOWNLOADING AND POST-PROCESSING DATA

These components were to be encased in a simple, eloquent system. DGIS was to be designed for a DoD user community including both intermediaries and end users. Databases would be both federal and commercial. In addition to large, well-known databases and systems, many small, specialized DoD databases would eventually be part of the DGIS. Resources would be required to identify these databases within DoD and to establish announcement and access permission.

Having identified the broad requirements of DGIS, a software survey was conducted to determine if a software product already existed which would meet its needs. The survey showed that "THE" system was not out there, waiting (Ref. 1). One software package, the Technology Information System (TIS), did provide a suitable foundation on which to begin constructing DGIS (Ref. 2). TIS was under development at Lawrence Livermore National Laboratory (LLNL) under the sponsorship of the Department of Energy (DOE) (Ref. 3). TIS functioned as an

intelligent gateway, capable of interconnecting heterogenous information resources at geographically distributed locations in an automated, unified, and controlled manner. In addition, TIS downloading and post-processing capabilities were already available for selected databases.

Having identified in TIS a hospitable environment for testing DGIS concepts, a strategy for DGIS prototype design and development was based upon its capabilities.

## 3. PROTOTYPE DESIGN

Project teams were assigned to each of the DGIS major components: Directory of Databases, Interface(s) for Searching Diverse Databases, and Post-Processing Capabilities. Over the course of the project, teams were added for DGIS interface development, user support, and prototype implementation. Each of these areas is described below.

### 3.1 Directory of Databases

The goal of this project team is two-fold: 1) identify and catalog existing databases and 2) make this information subject-searchable, so that information needs can be matched to relevant resources (Ref. 4). Although there are many directories that identify commercial and prominent federal databases, such information was not readily available for DoD databases. To fill this void, a questionnaire was addressed to the DoD Research and Development (R&D) community to identify extant databases, their scope, and availability. Over 400 databases were identified as a result (Ref. 5).

The next step was to build a database of DoD and DoD-relevant databases which had been identified. A user survey was conducted to determine database requirements (Ref. 6). A database schema was developed for the Directory and database entries were subject indexed. The database was built using the INGRES relational database management system.

The result of this effort is a small-scale, online Directory of Databases which contains information on the content, scope, and availability of selected databases. The Directory is subject-searchable, so that upon entering the topic of interest, the user is provided with a list of appropriate databases.

### 3.2 Interface for Searching Diverse Databases

One of the primary goals of DGIS is to relieve the user of the need to learn and master separate commands and protocols for each database accessed. As mentioned earlier, the DGIS target user community includes both end users and intermediaries. It is a rare intermediary who maintains proficiency in the use of more than ten systems and, for end users, two systems is high (Ref. 7). With the ongoing proliferation of databases, it is obvious that both end users and intermediaries will benefit from an interface for searching diverse databases. The project team assigned to this effort found that end user and intermediary interface needs are very different when considered in conjunction with today's technology. (An expansive natural language interface requiring artificial intelligence applications appealed to both populations, but could not be accomplished with existing technology in the short term.)

A dual approach was adopted for the interface design, incorporating separate strategies for intermediaries and end users. Eight database systems were selected for inclusion in the prototype model. These included three large federal systems and two small DoD systems.

A software survey was conducted to determine if interfaces existed which met DGIS needs. One of the "needs" that influenced the result of this survey was the requirement to support low-end, "dumb" terminal service on DGIS, as well as intelligent devices. Many of the software packages identified were designed for a microcomputer environment and had to be ruled out for use in the prototype. As a result of the survey, a decision was made to develop an interface for the intermediary and to integrate an existing interface for the end user.

For the intermediary, a command translator is being developed which allows the user to interact with any of the test systems using the command language he selects. The user, for example, could search NASA/RECON using DROLS commands or the reverse. Since some commands will not have an equivalent in another database, native command searching will be retained. This development work is being performed at LLNL under the sponsorship of DoD and NASA.

To satisfy the end user, the EasyNet database searching service has been integrated into DGIS. EasyNet is a menu-driven, database front-end which provides access to over 600 commercial databases. This service was tested by members of the DoD end user community who delighted in the simplicity of search execution. EasyNet access is now an option within DGIS.

### 3.3 Post-processing

Information retrieved from databases often requires analysis or post-processing in order to become useful to the researcher. This need had been recognized by DOE and they had developed many options for post-processing data from DOE/RECON through TIS. A library of post-processing routines for numeric and bibliographic data was available on TIS software and was incorporated in the DGIS project (Ref. 8). In order to post-process data, the user downloads it into a file on DGIS, translates the data into a common format, and calls up one of the many available post-processing routines.

The post-processing team tested existing post-processing capabilities, made recommendations for enhancements, and prioritized expansion of the capabilities to other databases.

### 3.4 DGIS User Interface Design

The interface incorporated in TIS software was structured to support users with a knowledge of the UNIX operating system. As a rule, the DGIS user community lacked this knowledge and was not inclined to invest the time required to acquire UNIX expertise. However, TIS software has a flexible design which allows the user interface to be tailored to the target user community (Ref. 9).

The team responsible for developing the DGIS interface incorporated menu and command modes into the interface (Ref. 10). The objective was to allow the novice user to interact with the system at ease, by descending through a series of menus. For the more experienced user, commands were incorporated to execute systems functions.

### 3.5 Prototype Implementation

Initial DGIS development, test and evaluation took place on TIS software at LLNL. DTIC sponsored a number of DoD users who agreed to test DGIS capabilities being developed at LLNL and make recommendations for system enhancements. These users were issued passwords and dialed into TIS at LLNL.

In parallel, the prototype implementation team developed a plan for acquiring the hardware, software, and telecommunications equipment required to support a DGIS prototype in the Washington, DC, area. A site was selected and installation was accomplished in February 1986. The prototype is running on a VAX 11/780 using the UNIX operating system and INGRES database management system.

### 3.6 User Support

As implementation and testing of the various DGIS modules began, it became obvious that success of the system would require some form of user support and training. A Gateway User Support and Training Office (GUSTO) was established to satisfy this need. GUSTO provides a hotline service which users can call when they have a problem. GUSTO staff will identify the source of the problem (i.e., the gateway, the user's terminal, a telecommunications link, a remote system, etc.) and take action to have the problem resolved. Users may also contact GUSTO staff utilizing an electronic mail capability which is available on DGIS.

Developing a user's manual and providing training courses are also GUSTO responsibilities. The training course is primarily designed for the professional searcher who wants to exercise the power of the system, especially in the area of post-processing of bibliographic data. The user's manual serves as a reference tool for the user. GUSTO staff will also poll the DGIS user community to identify new requirements.

## 4. STATUS

The prototype DGIS is currently undergoing test and evaluation within the DoD community. Thirty users have been selected to participate in the prototype evaluation. The group is comprised of end users and intermediaries.

Testing of DGIS began in March 1986 and will continue for a 12-month period. Currently, in the first month of prototyping, the major effort has been devoted to correcting a series of minor, but continuous, hardware and software problems. This has provided an opportunity to gain a first-hand knowledge of the "burn-in period" and "infant mortality."

Once these problems have been solved, the users will be brought onboard and the design teams will begin collecting data on the performance of their modules. System modification and fine tuning will take place to enhance performance. Six months into the prototype period, data will be collected on overall system ease of use and productivity improvements.

Success of the prototype will result in its operational implementation and expansion of the number and type of databases accessible through DGIS. Implementation of DGIS will provide DoD's scientific and technical community with a powerful, responsive information tool. DGIS will render timely, comprehensive information to DoD research, development, and engineering programs. The productivity enhancement within the community resulting from this information will more than offset the investment made in DGIS development and operating cost.

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# THE DoD GATEWAY INFORMATION SYSTEM (DGIS): USER INTERFACE DESIGN

A. D. Kuhn and G. A. Cotter

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Department of Defense (DoD) Research and Engineering (R&E) community requires rapid access to scientific and technical information relevant to their mission areas. The information they need is in a multiplicity of diverse databases maintained in the federal and commercial sectors. A tool being developed to satisfy these information requirements is the DoD Information Gateway System (DGIS). The Defense Technical Information Center (DTIC) is the program manager for the DGIS. A prototype version is now undergoing test and evaluation. The objective of the DGIS is to provide the DoD researcher with a single, easy-to-use interface for accessing, interrogating and post-processing information from the numerous databases relevant to their needs. To the user's mind, the DGIS transforms these resources into a single entity - a virtual database. DGIS includes a menu system as an option for handling information. The menu system guides the user through the paths of accessing and processing information via the DGIS. Development of this menu system is discussed in this paper.

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# THE DoD GATEWAY INFORMATION SYSTEM (DGIS): USER INTERFACE DESIGN

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ABSTRACT:

The Department of Defense (DoD) Research and Engineering community requires rapid access to scientific and technical information relevant to their mission areas. The information they need is in a multiplicity of diverse databases maintained in the federal and commercial sectors. A tool being developed to satisfy these information requirements is the DoD Gateway Information System (DGIS). The Defense Technical Information Center (DTIC) is the program manager for the DGIS. A prototype version is now undergoing test and evaluation. The objective of the DGIS is to provide the DoD researcher with a single, easy-to-use interface for accessing, interrogating and post-processing information from the numerous databases relevant to their needs. To the user's mind, the DGIS transforms these resources into a single entity - a virtual database. DGIS includes a menu system as an option for handling information. The menu system guides the user through the paths of accessing and processing information via the DGIS. Development of this menu system is discussed in this paper.

## I. INTRODUCTION

The Department of Defense (DoD) research and engineering community requires rapid, easy access to scientific and technical information relevant to their mission areas. The information they need is contained in a multiplicity of diverse databases maintained in the federal and commercial information sectors. A tool which is being developed to satisfy the information requirements of this community is the DoD Gateway Information System (DGIS).

The objective of the DGIS is to provide DoD researchers with a single, easy-to-use interface for accessing, interrogating and post-processing information from the numerous databases relevant to their needs. To the researcher's mind, the DGIS transforms those heterogeneous resources into a knowledge entity - a single, virtual database of his domain of expertise.

The Defense Technical Information Center (DTIC) is the program manager for the design, development and implementation of the DGIS. A prototype version of the DGIS is now undergoing test and evaluation. Eight information services have been selected as targets of the prototype gateway (1). Access, command, downloading and post-processing routines are being developed to provide the user with the single, easy-to-use capability to handle the vast amount of information in the virtual database entity that constitutes the user's knowledge domain.

Currently, three user interface modes for accessing and handling this information are being developed and applied in the DGIS to get the user to his domain. These modes are menu, command, and an off-the-shelf user assistance access and search interface. The use of these modes is optional, depending on the user's skill level in both using DGIS and accessing diverse databases. These modes are available now in their various developmental levels of functionality, but all highly usable. A fourth area, still in basic development, is a system common command language capability, to give relief to the problem of having to address databases in each of their native command languages.

As mentioned, the modes are made available to the researcher to use at his discretion for accessing and handling information. The assistance interface services the casual, novice user for accessing and aggregating information from diverse databases. The DGIS menus lead the more knowledgeable novice user through the paths of getting the information and processing it, and the DGIS commands that the novice learns in the process will raise the skill level to command mode for more rapid information handling. Since the menus are pivotal to using DGIS, this paper speaks to the development of the DGIS menu interface.

## II. BACKGROUND

The Defense Technical Information Center (DTIC) is charged with providing information services to the

Department of Defense scientific and technical community. These services range from collecting and disseminating bibliographic information to sponsoring and directing research into innovative information handling technologies. DGIS, in development to provide online, streamlined methods for identifying, accessing, searching, post-processing, and analyzing information from diverse databases, is one of DTIC's most important developments to promote access to scientific and technical information database resources (2).

DGIS has been developed on the Technology Information System (TIS), a Department of Energy system resident at Lawrence Livermore National Laboratory (LLNL), Livermore, CA. TIS is a prototype information gateway which is the pattern system on which gateway nodes are in various stages of development for Energy, Defense, and NASA, with nodes also planned in other agencies. TIS, as an intelligent gateway processor, is well along in its development. It supports access to external resources, the downloading and uploading of data, simultaneous searching, and post-processing (3). This particular orientation is an application of the Berkeley UNIX software development, with which TIS is further developing software for intelligent gateway computers suitable for the prototyping of advanced, integrated information networks. TIS developers use it to lead the user to information resources by means of a directory and automated access procedures, with the overall goal of transferring information and technology acquired from and among the wide range of geographically dispersed information resources (4).

Major requirements for the use of DGIS have been determined through DTIC user community surveys and site visits. These requirements showed six critical areas for incorporation into a DoD gateway system (5). These areas were:

- A gateway user interface
- A directory of databases
- Remote database connection routines
- Common data retrieval routines
- Simultaneous search capabilities
- Data analysis and post-processing routines

The DGIS was to be built on the concept of giving the user a means to process information with a computer system, as compared with a computer system processing information in a pre-determined way and then handing that information to the user. The requirements in establishing the basis for the utilization of the system also implied the conceptual structure for the system's menus, to function through the foundational TIS software capabilities.

## III. DEVELOPMENT OF THE MENUS

### 1. Menu Use Concepts

The initial task in designing the menu system was to define the full range of DGIS capabilities and to identify those which would benefit our users. An array of commands existed which were a compilation of UNIX operating system commands and TIS commands. Additionally, there was a number of modular menus which had been designed for a UNIX-facile user community -- definitely not the DGIS community. The first order of the DGIS menu structure was to unify the commands and the menu sets. This unification was to serve as a basis for leading the DGIS user through the functions and capabilities of the system.

A primary concept was the inclusion of a user-usable command language. No lengthy discussion was needed to conclude that a usable language is English. Command length was not considered a hindrance since commands would rarely be more than one word. The structure of the menus, therefore, included incorporating the actual commands as indicators of the capabilities and functions.

Realizing, however, that to go through the menu structure on English language commands alone would require constant and repetitive key-stroking, number indicators were incorporated. A number not only serves as a surrogate command but also indicates the menu area and level.

Menu area access was considered to be an important issue. Going up and down through the menus to get from one capability module into another was judged to be tedious. The concept of accessing any menu module at any level from any area in the menu structure was incorporated. Furthermore, this concept included returning to menu area point of change, in the user's processing of his information. This concept application is useful, for example, in working with a file, and on judging it to be ready for presentation, going from the files module to the electronic mail module to transfer that file to another user. The user then reverts to the menu area in which he was originally working. The very basic idea of the

menu access concept, therefore, is that access is up/down, sideways, diagonal, jump-around, and reversion.

Furthermore, we realized in looking at other menu systems the strong advantage of incorporating a method of menu-use continuity, or at the very least, a way to escape when a process becomes confusing. We have therefore included a set of command option constants to accomplish continuity, displayed at the botton of each menu display. These options allow the user at any time to enter any menu number, any command, backup to higher level menu, go back to the DGIS top menu, or simply end the session.

## 2. Conceptualizing the DGIS Menu Interface

A review of the task effort pointed out that a DGIS menu interface had to be based on a clear understanding of the DGIS mission requirements. Therefore, the basic functions of DGIS in fulfilling its mission were delineated, with the help of the requirements study, as follows:

a. Inclusion of a database directory. With over 3000 databases online containing scientific and technical information, users generally have a comprehensive selection from which to extract knowledge in their domains. But with an ever-expanding number of databases, it is an awesome task to both keep track of pertinent databases and maintain awareness of new ones. The DGIS directory is to maintain awareness of the database universe and to be subject searchable so that the researcher may get a list of pertinent databases.

b. Remote database connection routines. Communications are the backbone of any gateway system. DGIS users are to access not only information databases but also people. DGIS communication capabilities, then, break out into connection routines for automatically logging into databases and telecommunication networks, electronic mail, online realtime interactive communicating between users, and simple dial access to systems not included in the automatic connect routines.

c. Common data retrieval routines. This area is still in initial research and development for DGIS, and based on a review of the literature, also apparently in general. This concerns the establishment of common retrieval facilities such as a common command language, cross-command translated language use, and a wide range of software appplications for front-ending databases. In relation to the DGIS menus, however, common data retrieval routines will be incorporated as options. The user will invoke them through the menu or by command. DGIS has made an initial step in this direction by making available an experimental front-end interface for accessing and searching databases. This has been incorporated as SearchMAESTRO (6) in the menu.

d. Simultaneous search capabilities. Realizing that comprehensive information relevant to the researcher's need is scattered throughout diverse databases, a query may be run against those databases simultaneously. Search results are viewable on the terminal screen foreground, or may be relegated to background processing, thereby freeing the screen for other tasks.

e. Data analysis and post-processing routines. After having aggregated information from diverse databases, there is often a need to analyze or post-process that information for it to be useful to the researcher. Because of the sheer volume of information that is possible to collect, the DGIS includes automated methods for analyzing and processing large amounts of data. The ability to reformat, merge, sort and analyze data downloaded from remote databases to the benefit of the researcher catalyzes the transformation of an information glut into information gold (7).

## 3. STRUCTURING THE DGIS MENUS

Structuring the menus according to the system needs and capabilities was an exercise in:

a. Delineating the parameters of the system requirements,

b. Conceptually merging those needs and the system capabilities,

c. Partitioning the needs-capabilities into modules,

d. Interfacing the modules and their sub-functions correctly, and

e. The dirt-deep nitty-gritty writing of the menus.

The DGIS base menu as a consequence served not only as the top, or first menu, but also as an announcement of the system's major capabilities and features. Initially, this menu incorporated:

a. The requirements of a directory of databases.

b. Communications capabilities, including remote database connect routines and connecting with people, and the already mentioned SearchMAESTRO search interface.

c. Routines for downloading information, including simultaneously.

d. Routines for processing information as a means for making compilations of information more useful to the user.

Additionally, included in the base menu were supporting features furnished by the software:

a. A separate electronic mail feature.

b. A files manipulation operations set.

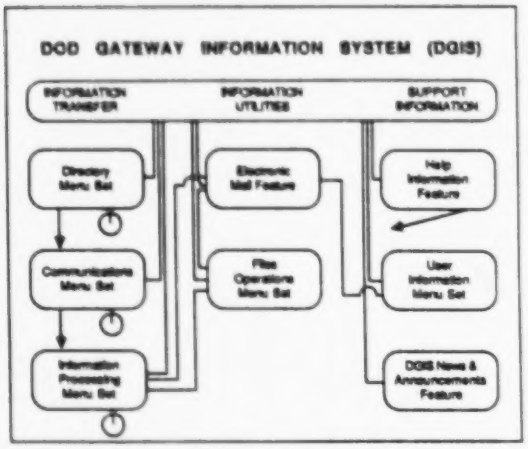
c. A searchable DGIS users directory feature.

d. A DGIS "What's New" (news) feature.

As these major features gathered together, a higher-level taxonomy became evident, not handed down in stone, but to be indicated on the main menu as a means of separating and giving order, in the user's view, to the basic features relative to the DGIS mission. The taxonomy was:

**Information Transfer Modules-** This category brings together the remote information access and processing features.
**Information Utilities-** This category brings together the features that allow the user to manipulate and transfer the information.
**Support Information-** This category convocates the internal DGIS information considered useful to the user and therefore made accessible.

Concurrently, the module interfaces for the menus also became clear. The order and relations were charted diagrammatically to ascertain the menu interfaces, as follows:

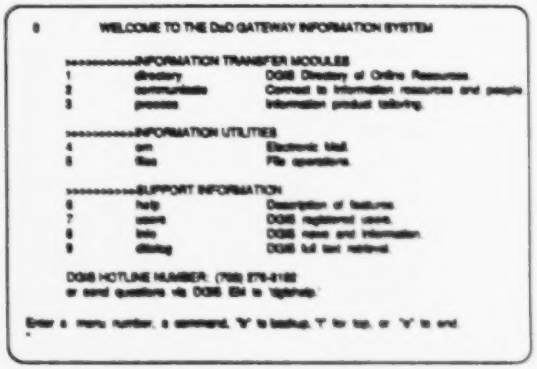



Concept changed into substance through this diagram and the DGIS menu interface acquired reality.

## IV. THE DGIS MENUS

### 1. The Top Menu

The DGIS top menu, in starting the user off on his information processing journey through the system, not only displays the major capabilities of the system, but in doing so also serves as a marketing device for the system. The top menu comes up immediately on logging-in to welcome the user to the system, and he sees:



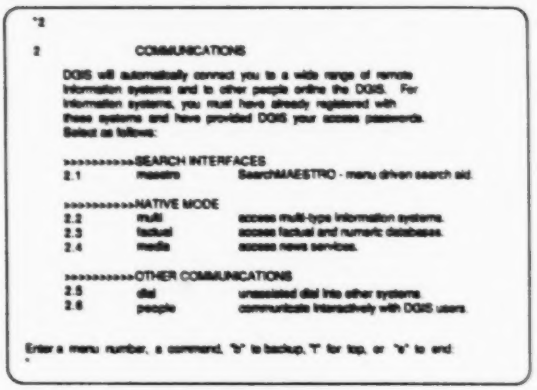

### 2. Sub-Level Menus

The top menu branches into the second level DGIS functional menu sets. Each menu at that level includes a concise explanation of the function module, with descending function-specific subsidiary menus as needed that lead the user through the processes.

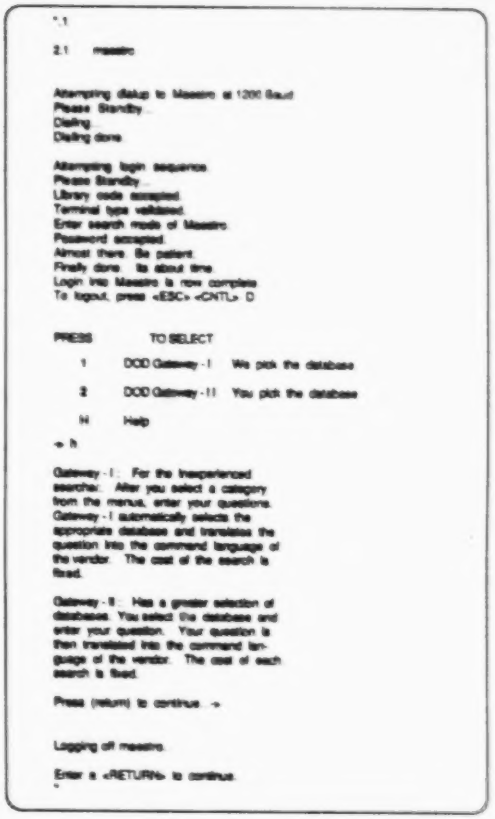
Since the displays themselves give the best view of a menu-driven system, let's use our Communications module as

an example. The following shows each menu and a response. Note that each menu includes the continuity options at the bottom and a numeric menu area and level indicator at the top. Additionally, each response or process conclusion includes the continuity instruction of entering a carriage return to continue.

Thus, at the prompt in the top menu one enters "2" (or "communications") and brings up this second level menu to select and begin the desired communications process:


*2
2 COMMUNICATIONS
DGIS will automatically connect you to a wide range of remote information systems and to other people online the DGIS. For information systems, you must have already registered with these systems and have provided DGIS your access passwords. Select as follows:
>>>>>>>>>>SEARCH INTERFACES
2.1 maestro SearchMAESTRO - menu driven search aid.
>>>>>>>>>>NATIVE MODE
2.2 multi access multi-type information systems.
2.3 factual access factual and numeric databases.
2.4 media access news services.
>>>>>>>>>>OTHER COMMUNICATIONS
2.5 dial unassisted dial into other systems.
2.6 people communicate interactively with DGIS users.
Enter a menu number, a command, 'B' to backup, 'T' for top, or 'X' to end:
*

The display of DGIS communications and access functions illustrates how the second level menu provides a choice of specific functions. The menu also categorizes the communications functions to indicate the multiple options that DGIS is offering for accessing information resources. The first option in this case is the SearchMAESTRO user search assistance interface already mentioned. So, if one enters the menu number (or command) for maestro, one gets:


*1
2.1 maestro
Attempting dialup to Maestro at 1200 Baud
Please Standby
Dialing
Dialing done
Attempting login sequence
Please Standby
Library code accepted
Terminal type validated
Enter search mode of Maestro
Password accepted
Almost there. Be patient.
Finally done. Its about time
Login into Maestro is now complete
To logout, press <ESC> <CNTL> D
PRESS TO SELECT
1 DOD Gateway - I We pick the database
2 DOD Gateway - II You pick the database
H Help
-> h
Gateway - I: For the inexperienced searcher. After you select a category from the menus, enter your questions. Gateway - I automatically selects the appropriate database and translates the question into the command language of the vendor. The cost of the search is fixed.
Gateway - II: Has a greater selection of databases. You select the database and enter your question. Your question is then translated into the command language of the vendor. The cost of each search is fixed.
Press (return) to continue. ->
Logging off maestro
Enter a <RETURN> to continue.
*

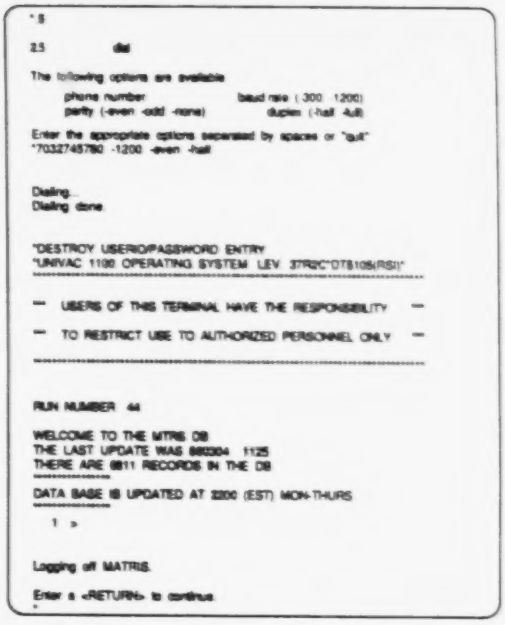
Relative to this option, the automatic connect process may seem a little tongue-in-cheek. But its purpose is to let the user know what is going on during the extended connect and access period. The response display initiates the user to the maestro function. One follows the interface's menus until ready to leave through the <ESC> <CNTL><d> command. This activates the automatic logout and brings up the DGIS instruction to <RETURN> to continue. The return brings back the Communications menu.

If the researcher should want to search a remote database in native mode, he may again enter a menu number or the command shown to descend to a sub-level menu which brings him to function-specific options. In the

case below, he has entered "multi," as shown on the Communications menu. This brings up the sub-level menu showing the multi-type category of information systems. This particular sub-level menu shows the menu numbers (and command entries) for systems with which DGIS has automatic connect routines. This menu is also represent ative of the other native mode database categories shown on the Communications menu. In the illustration below the user has again chosen to enter the command line, rather than the menu number (which may mean that he is on the verge of using commands directly rather than through the menus for quicker information processing..):

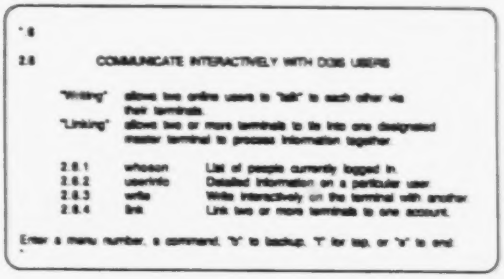
Again, relative to this particular entry, the response display shows the process of the connect routine, then the researcher's entry into the DIALOG database down to the logout routine and the DGIS appearance of the "RETURN to continue" instruction, to lead back to the Communications menu.

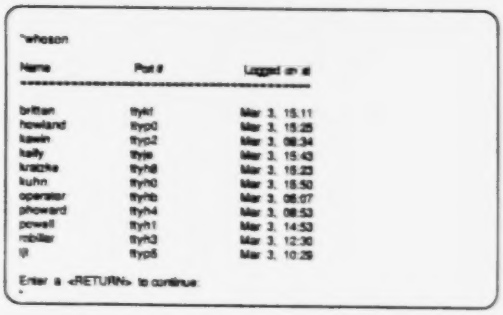
In the communications area, DGIS provides the capability for users to dial into any system they can access with their access codes. Obviously, "dial" is good for systems for which DGIS does not have automatic connect routines. Also, in the illustration below although the user might have accessed the MATRIS database with the connect routine, he also may not yet have been granted DGIS access. But he has elected to access MATRIS through DGIS in order to keep his information from diverse databases together in his DGIS account. He therefore has entered the menu number for "dial," and responding to the "dial" sub-level menu he will enter the appropriate information to have DGIS access MATRIS, as shown by the display:

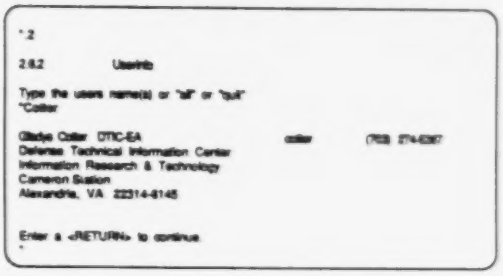

The following options are available
phone number baud rate (300 1200)
parity (-even -odd -none) duplex (-half -full)
Enter the appropriate options separated by spaces or "quit"
Dialing...
Dialing done
"DESTROY USERID/PASSWORD ENTRY
"UNIVAC 1100 OPERATING SYSTEM LEV 37R2C*DT8105(RSI)"
USERS OF THIS TERMINAL HAVE THE RESPONSIBILITY
TO RESTRICT USE TO AUTHORIZED PERSONNEL ONLY
RUN NUMBER 44
WELCOME TO THE MTRS DB
THE LAST UPDATE WAS 880304 1125
THERE ARE 8811 RECORDS IN THE DB
DATA BASE IS UPDATED AT 2200 (EST) MON-THURS
Logging off MATRIS.
Enter a <RETURN> to continue.

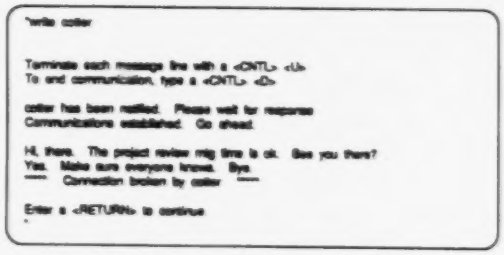
## 3. Subsidiary Level Menus

Lower level menus are incorporated as needed. For example, in DGIS people also are considered as information resources. DGIS therefore includes in its Communications options contacting people directly. The following subsidiary-level menu and the menu responses explain in themselves the DGIS function in interacting with people online, and serve as an example of a subsidiary menu function.


COMMUNICATE INTERACTIVELY WITH DGIS USERS
"Writing" allows two online users to "talk" to each other via their terminals.
"Linking" allows two or more terminals to be tied into one designated master terminal to process information together.
2.8.1 whoson List of people currently logged in.
2.8.2 userinfo Detailed information on a particular user.
2.8.3 write Write interactively on the terminal with another.
2.8.4 link Link two or more terminals to one account.
Enter a menu number, a command, "b" to backup, "t" for top, or "s" to end.



Type the user name or the terminal identifier you wish to link to
or "quit"
Type 'Y' for student, 'T' teacher or "quit"
Do you want to keep a transcript of this link?
Type "yes" "no" "quit"
Type in the file name to contain this link session.
All Done!
Enter a <RETURN> to continue

## V. SUMMARY

Above is the menu progression of one capability in DGIS. This progression, however, shows how the menu sets have been designed and interfaced to lead the researcher through the otherwise torturous paths for getting to and handling information acquired from external sources. The purpose of the system is not only to allow the user the capability to process information on his own terms, but in doing so to also process knowledge which has accumulated throughout the wide range of resources in his domain of expertise. This means not only communicating with database resources but also with "peoplebase" resources scattered over the United States and the world.

After getting their information, researchers may then use the wide range of processing routines in DGIS to tailor their own information aggregations into forms useful to them. The goal of DGIS, therefore, is to get people to the widely-diverse and widely distributed information in their knowledge domains, and to get that information to the people.

## VI. ACKNOWLEDGEMENTS

Ms. Roberta Cohen, Ms. Marjorie Powell and Mr. Curtis Generous, of DTIC, formed the team that developed and implemented the DGIS menu interface design.

## VII. NOTES

(1) The eight target databases are:
- DoD RDT&E On-Line System (DROLS), DTIC
- Manpower and Training Information System (MATRIS), DTIC
- Department of Energy Information System (DOE/RECON))
- NASA Information System (NASA/RECON)
- Robotics and Artificial Intelligence Database (RAID), NSWC
- DIALOG
- ORBIT
- BRS

(2) Cotter, G. A. The DoD Gateway Information System. Defense Technical Information Center, Alexandria, VA, October 1985, AD-A161 701, p.1.

(3) Cotter, G. A. et al. The Integrated Information System: Resource Sharing Tailored for Local Needs. Defense Technical Information Center, Alexandria, VA, November 1985, AD-A161 700, p. 6.

(4) Hampel, Viktor, et al. "TIS"-An Intelligent Gateway Computer for Information and Modeling Networks: Overview. Lawrence Livermore National Laboratory, Livermore, CA, August 1983, UCRL-53439, p. 1.

(5) ibid. (2), p. 2.

(6) SearchMAESTRO: Menu-Aided Easy Searching Through Relevant Options.

(7) ibid. (2), p. 4.